Test method to assess the survival probability of capsules in self-healing concrete

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Capsules developed for use in self-healing concrete may not break during concrete mixing and placement, but should break upon crack formation to release the healing agent for crack repair. In this paper, the main focus will be on methods to assess the survival probability of capsules during concrete mixing.

At laboratory scale, the survival probability of capsules during concrete mixing can be easily determined by (i) counting the capsules which are still intact after mixing and (ii) comparing this value with the original number of capsules added to the mix. However, this method is time-consuming and not applicable for large concrete mixes. Therefore, a method was developed within the M-ERA.Net project CAPDESIGN in order to assess more easily the capsules survival rate during their introduction in concrete, by filling the capsules with setting accelerator and determining the impact of the addition of capsules on the consistency and the setting of the concrete.

First, the influence of different amounts of setting accelerator on the properties of fresh and hardening concrete has to be determined by e.g. consistency tests, penetrometer measurements which allow to determine the initial and final setting time of concrete (ASTM C403) or US measurements for continuous monitoring of the setting behaviour (FreshCon device). In that way, a calibration curve can be composed. Secondly, mixes containing the encapsulated setting accelerator have to be made and the same tests have to be performed. Based on the calibration curve, the amount of setting accelerator released can then be determined, giving an indication of the number of capsules which have survived the mixing process by taking into account the internal volume of the capsules. Attention has to be paid that the mix composition (except the accelerator or capsule content), mix procedure, test conditions (e.g. temperature) and testing procedures are kept constant during the calibration and the effective tests. Otherwise, false results may be obtained.